FALL 2017

QUANTUM TIMES

Inside This Issue:

GIVE NOW!

NEW MEXICO STATE UNIVERSITY
DEPARTMENT OF PHYSICS NEWSLETTER

Alumni

Alumni support is essential to having a strong, vibrant department. We hope that reading this newsletter will inspire you to help the Physics Department with your tax-deductible donation. See page 2 for details!

Editor: Tegan Fuqua

A Message from the Department Head

Dr. Stefan Zollner

Dear Alumni and Friends:

We hope you enjoy our spring 2017 newsletter with information about our students, alumni, and faculty. We have had a great year and are likely to award 19 undergraduate degrees in 2017, setting a new record. Many of our alumni are highly successful and take lucrative positions with companies or federal labs in the Southwestern US. Others go to graduate programs in physics and engineering across the country, such Rice University and other prestigious colleges.

Unfortunately, our undergraduate enrollment has been decreasing from a record of 99 two years ago to only 80 this fall. We would greatly appreciate you help to recruit more physics and engineering physics students. Please talk to your friends and, if possible, local schools about the high quality of our programs and the broad value and excitement of a physics education.

Financial support is fundamental to the success of students in our program. Some switch majors to other fields where donors have endowed bigger scholarships. Graduate students often prefer UNM, where they get paid better. Some students have long commutes from Silver City, Fabens, or Alamogordo because they cannot afford to live in Las Cruces. Others struggle with their academic assignments because they must work two off-campus jobs to make ends meet. State support in the form of the lottery scholarship is declining, now covering only 60% of tuition (not including fees and housing).

We are grateful for two large donations this year from George Goedecke and from Gale Harvey, which have a tremendous impact on the success of our students. **In this newsletter, I again ask for your donation to our scholarship funds. Even small donations can make a big difference.** If you have not given to our department before, can you support us with $10 or $20 this fall?

Best regards and thanks for your support.

Stefan Zollner

I am supporting the NMSU Physics Department's needs with my personal gift of $_____ .

Name: _____ Major: _____

Address: _____ Degree: _____

Email: _____ Year degree awarded: _____

Additionally, my company (or my spouse's company) will match this gift: yes / no
Enclosed is the company's matching gift form.

My gift is to be used as follows (Appeal Code #20792):

____ Goedecke Graduate Fellowships (982254)
____ Engineering Physics Scholarships (102911)
____ Undergraduate Physics Scholarships (102910)
____ K-12 Outreach (972251)

Please enclose a check made out to "NMSU Foundation, Inc." If you prefer to use a VISA or MasterCard, please fill out the following.

_____ VISA _____ MasterCard

Card No. _____ Security Code _____ Exp. Date _____

Print Name _____ Signature _____

Please send your donation to:
Rosa Christensen
MSC 3D
PO Box 30001
Las Cruces, NM 88003

All contributions to the NMSU Physics Department are tax-deductible as allowed by law. For more information on ways you can make a difference in the physics department, please contact Dr. Stefan Zollner, the department head, at: 575-646-7627 or zollner@nmsu.edu .

Engineering Physics: The Best of Both Worlds

NMSU's Engineering Physics (EP) program incorporates a curriculum of both engineering and physics classes to prepare students for graduate school and work in industry and national labsl. after graduation. The EP program offers students hands-on experience, allowing them to tackle real-life problems and giving them valuable work experience. EP students can choose aerospace, chemical, electrical, or mechanical engineering as their area of concentration. Each area offers students the opportunity to learn the fundamentals of both physics and their chosen engineering discipline and the practical applications of each. Engineering physicists work in a wide range of fields, including information technology, nanotechnology, and nuclear power. Their dual training in physics and engineering makes them flexible, making them well-suited to work on teams of specialists.

Both EP faculty and students are involved in a wide range of research projects and participate in several on-campus student organizations, such as the Society of Physics Students (SPS) and the Society of Engineering Physics students (SEPh). The faculty have extensive experience in both academia and industry and have a wide and established collaborative network that extends throughout national facilities and various companies.

A unique aspect of NMSU's EP program is the close collaboration between students and professors during program assessment. The EP Advisory Board, which consists of ten high-level representatives from industry, national labs, and academia, meets annually at NMSU. EP students are invited to advisory board meetings, where students and board members discuss such things as degree plans and required classes. Students are encouraged to offer their input and have an active role in designing their education. Students and board members discuss the EP program, focusing on issues students have come across and what they have found that works well. This collaboration fosters a connection between students and those who design their programs of study and gives students more control over their education.

The 2016 engineering physics advisory board meeting. Engineering physics students and board members listen as a student answers a question about the program posed by a board member.

Graduate Student Profiles

Samantha Sword-Fehlberg

Samantha Sword-Fehlberg is a doctoral physics student at NMSU. She is a New Mexico native, hailing from the mountain town of Cedar Crest. She earned her Bachelor of Science in physics and astronomy from Northern Arizona University in 2016. She began attending NMSU in the fall of 2016. Ms. Sword-Fehlberg's area of concentration is experimental nuclear research.

Since beginning her academic career at NMSU, Ms. Sword-Fehlberg has contributed extensively to the physics department's academics. She has been a Supplemental Instruction teacher, a lab instructor, and a math and physics tutor. She is also the current secretary for the Physics Graduate Student Organization. Ms. Sword-Fehlberg helped organize the department's Physics Fun Day and recruited volunteer judges for the 2017 NMSU Science and Engineering Fair. Finally, she is a student Member-at-Large of the Four Corners Section of the American Physical Society (APS).

Ms. Sword-Fehlberg started work as a research assistant this fall. Her research will focus on using deep learning to find and identify neutral-current neutrino scattering events in Fermilab's MicroBooNE experiment.

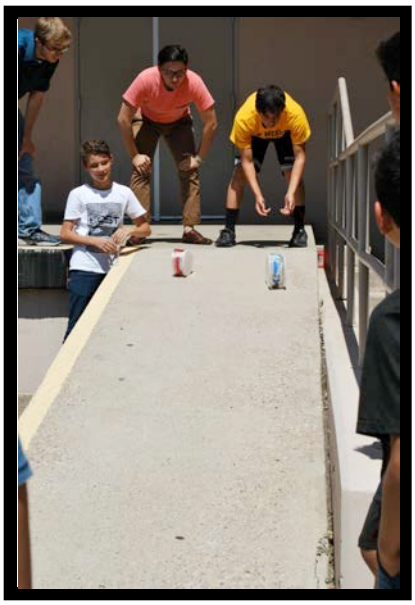
Richard T. Mbatang

Richard T. Mbatang is a doctoral physics student at NMSU. He is originally from the Northwest Region of Cameroon. Mr. Mbatang earned a bachelor's in physics from the University of Buea in the Southwest Region of Cameroon. Before he came to NMSU, Mr. Mbatang taught science and math at the Darasamutr School in Chonburi Province, Thailand. His research interests are the synthesis, characterization, and application of thin films, nanostructures, and multifunctional materials. For the 2016-2017 academic year, Mr. Mbatang is the recipient of The Preparing Future Faculty Assistantship award. This award supports the preparation of future higher education faculty. In his free time, Mr. Mbatang enjoys perusing the news, playing soccer, and cooking African food. He lives with his wife and daughter. After graduating from NMSU, he plans either to work as a materials scientist in the semiconductor industry or to teach in higher education.

Samantha Sword-Fehlberg: Member-at-Large

As a Member-at-Large of the Four Corners Section of APS, Ms. Sword-Fehlberg's job is to cultivate and support a good relationship between the Executive Committee and the student population of her Section. Any student grievances or suggestions are submitted to her and she passes them on to the Executive Committee. Ms. Sword-Fehlberg then works with the Committee to find the best possible solution. It is also her responsibility to help organize and run the annual Four Corners Section conference. Finally, she is in charge of awarding the Spherical Cow Award at the annual meeting. The Spherical Cow Award recipient is chosen by students who attend the conference. This person is designated as having presented the best non-student talk.

NMSU Physics Summer Camp 2017



NMSU's 2017 Physics Summer Camp, led by SPS president Rachel Ridgeway, was held July 10 to July 14 and attracted fifteen students. Ages and grade levels ranged from 13 to 17 and 9th to 12th, respectively. Students explored various physics topics, including mechanics, electricity and magnetism, and spectroscopy. Each morning, there were brief lectures pertaining to the day's topic, followed by related hands-on activities and projects each afternoon. On Monday, students were introduced to fundamental math and physics concepts and were taught the basics of mechanics and angular momentum. To apply what they learned, students strategically placed washers inside plastic bowls, which they then raced in a downhill derby. Students explored electricity and magnetism on Tuesday, constructing circuits in series and parallel and penny batteries and working through various thought experiments.

On Wednesday, students learned about the wave properties of light. In the afternoon, they built their own spectroscopes. Thursday, students learned about the particle properties of light, relativity, and how to safely observe the sun and the upcoming solar eclipse. On Friday, students and counselors discussed topics of interest chosen earlier in the week by students. The day was concluded by applying various concepts learned throughout the week to successfully aim and fire a water balloon slingshot. An impromptu water balloon fight followed target practice, pitting the camp counselors against the students, who emerged victorious. The summer camp is funded in part by the Dr. Horace Coburn Fund.

Featured Physics: Nuclear and Spin Physics

For several years, Dr. Pate has led the physics department's nuclear and spin physics research efforts. He and his team, which consists of Dr. Vassili Papavassiliou, two post-doctoral researchers, and four students, focuses on the contributions of quarks and gluons to the spin-1/2 nature of protons and neutrons. Currently, this research group is involved in three projects: PHENIX, MicroBooNE, and E-1039. In the PHENIX experiment at the Relativistic Heavy Ion Collider at Brookhaven National Laboratory, beams of spin-polarized protons collide with other protons or nuclei. Observations are made of how often various events occur with respect to the spin orientation of the incoming proton. In the MicroBooNe experiment at Fermilab, a beam of neutrinos passes through a target-detector system filled with liquid argon. The neutrinos are naturally 100% polarized and interact with the argon nuclei. Observations of the debris from these interactions provide information about the spin part of the proton wave function. Most recently, Dr. Pate's team has joined the E-1039 experiment at Fermilab. In this experiment, an unpolarized proton beam is directed onto a target of polarized protons. The rate of annihilation of quarks with anti-quarks is then studied.

Alumnus Profile: Dr. Don Cleveland

Dr. Don Cleveland graduated from NMSU in 1972 with a bachelor's in physics. He earned a doctorate in biochemistry from Princeton University in 1977, where he identified and characterized the tau protein. The tau protein plays a key role in chronic traumatic encephalopathy (CTE) and is also associated with Alzheimer's and Parkinson's diseases. After graduating from Princeton, Dr. Cleveland completed a postdoc at the University of California, San Francisco. He then took a faculty position in the biological chemistry department at the Johns Hopkins University School of Medicine. Dr. Cleveland currently works at the San Diego Branch of Ludwig Cancer Research at the University of California, San Diego.

Dr. Cleveland's work has examined various causes of and treatments for ALS and Huntington's disease. His research has identified the steps involved in triggering and accelerating the advancement of ALS. Dr. Cleveland's research also has wider implications for neurodegenerative and neuromuscular diseases, such as spinal muscular atrophy. He has developed gene silencing therapies for human neurodegenerative diseases and clinical trials for therapies involving Alzheimer's and Parkinson's diseases and CTE are ongoing. In the future, Dr. Cleveland will focus more on CTE in addition to furthering his research in diseases such as Alzheimer's, Huntington's, and Parkinson's.

Featured Professor: Dr. Stephen Pate

Dr. Stephen Pate graduated summa cum laude from North Carolina State University (NCSU) in 1981 with a bachelor's in physics. While at NCSU, he worked on a two-year theoretical project concerning the ordering of hydrogen molecules in two- and three-dimensional materials. His project secured him an undergraduate research award. In 1987, Dr. Pate earned his doctorate from the University of Pennsylvania (UPenn). His thesis work involved measuring the lifetimes of excited nuclear states and using phenomenological shell model potentials to reproduce the measurements. As a graduate student, he also worked on projects involving the role of high angular momentum states in heavy ion scattering. He continued this work as a research associate at UPenn.

From 1988 to 1991, Dr. Pate was a research associate at the Indiana University Cyclotron Facility. There he worked on polarized neutron-neutron radiative capture and on the initial internal target experiments at the IUCF cooler, an electron-cooled proton storage ring. Dr. Pate then moved to a research associate position at the Massachusetts Institute of Technology (MIT) from 1992 to 1993. While at MIT, he worked on single- and double-charge exchange experiments at the Los Alamos Meson Physics Facility. These experiments featured the first use of the neutral meson spectrometer and the construction of a moderate solid angle array of proton detector telescopes. From 1994 to 1995, Dr. Pate was a research scientist at MIT, where he worked on the HERMES experiment. He began his career at NMSU in 1995 when he became an assistant professor. He was promoted to associate professor in 2001 and professor in 2006. In 2006, Dr. Pate also received the Gardiner Professorship, an endowed chair.

Physics 2016/2017 Undergraduate Directory

2016

Bachelor of Arts, Physics

Jeremiah Zamora

Bachelor of Science, Engineering Physics

Jacob Wright

2017

Bachelor of Arts, Physics

Federico Alvarez
Alexandra Hartman

Bachelor of Science, Physics

Michael Allen
Roberto Araujo
Zachary Chiodini
Jacqueline Cookie
Waverly Gorman
Dominik Martens
Troy Powell

Bachelor of Science, Engineering Physics

Luis Barrera
Avien Flores
Israel Jaramillo
Jaime Moya

Doctorate

Jesus Saenz

Physics Department Highlights

•The geophysics program, led by Dr. Waszek, received $75,000 in funding from the National Science Foundation to pay for a 304-core computer cluster.

•Tia Miceli, a post-doctoral researcher with Dr. Pate and Dr. Papavassiliou's nuclear physics group, took a Data Scientist position with Allstate Insurance in April 2017.

•For the first time, Dr. Edwin Fohtung's research team observed three-dimensional topological vortex in ferroelectric nanoparticles and demonstrated the ability to control it with an external electric field. This discovery has the potential to be applied in the next generation of electronics, non-volatile memory, and energy and information storage, among many other possible uses. The results were published in *Nature Communications*.

•Dr. Stefan Zollner was recognized by the American Vacuum Society (AVS) for his contributions to spectroscopic ellipsometry and x-ray scattering and his determination of optical functions of various materials.

•Dr. Robert Cooper and physics graduate student Hector Moreno collaborated on an experiment at Oak Ridge National Laboratory, which used the world's smallest neutrino detector. The research results, published in *Science*, showed the first measurement of coherent scattering of low-energy neutrinos off of nuclei.

•Dr. Nalin Fernando, a former Ph.D. student in condensed matter physics, took a position as a photolithography (patterning) engineer in the microelectronics industry at Intel in Oregon. He joins Dr. Lina Abdallah, who graduated in Summer 2014.

•Dr. Zollner's research group acquired a Fourier-transform infrared ellipsometer, which measures the refractive index and absorption coefficient of materials at wavelengths between 2 and 40 micrometers. This allows the study of narrow band-gap semiconductors for infrared emitters and detectors and the lattice vibrations of ionic crystals.

Undergraduate Student Profiles

Michael Kaemingk

Michael Kaemingk is an undergraduate in engineering physics with a concentration in electrical engineering. He is interested in applying the skills he learns at NMSU to developing technology for generating, storing, and transmitting electricity. He also wants to design technology that will advance experimental physics, such as particle detectors. For the past year and a half, Mr. Kaemingk has worked with the physics department's Dr. Robert Cooper, who specializes in experimental nuclear and particle physics. During Summer 2016, Mr. Kaemingk accompanied Dr. Cooper to work at the Center for Exploration of Energy and Matter (CEEM) in Bloomington, Indiana. While at CEEM, Mr. Kaemingk and Dr. Cooper built and tested a liquid argon neutrino detector.

During Summer 2017, Mr. Kaemingk participated in the University of Michigan's Research Experience for Undergraduates (REU) at CERN in Geneva, Switzerland. His work focused on testing pixel sensors for the inner tracker of the ATLAS detector, one of the two detectors used to discover the Higgs boson. Mr. Kaemingk describes his time at CERN as "one of the most intensive educational experiences" he has ever had. His programming and data analysis skills were challenged and, as a result, improved "more than ever." Of the people with whom he worked, Mr. Kaemingk says, "They made me feel like my work was significant." He also found his time at CERN to be a great cultural experience. Mr. Kaemingk was able to meet and interact with people from around the world and visit "some beautiful places in Europe."

Zachary Yoder

Zachary Yoder is a student at Arrowhead Park Early College High School. He is enrolled in Heat, Light, and Sound at NMSU and is a member of Dr. Zollner's research group. Mr. Yoder began working with Dr. Zollner in Summer 2017. He enjoys all aspects of physics, but wants to concentrate on particle physics and quantum mechanics and conduct research in one of these fields. Mr. Yoder's work with Dr. Zollner has "solidified [his] desires to work" in physics. During his time in Dr. Zollner's research group, Mr. Yoder has learned how to use the various machines, such as an x-ray diffractometer, employed by the group, their fundamental workings, and the math and science that governs them.

A majority of Mr. Yoder's contribution to Dr. Zollner's research group has been to assist the graduate student members with their projects. For example, he takes measurements for them and cuts thick metal samples into more manageable sizes. Mr. Yoder's status as a high school student has had no negative impacts on his work with Dr. Zollner. He is still extremely interested in physics and has been able to learn a great deal from his time with Dr. Zollner's research group.